



(12) APPLICATION

(11) **20171905**

(13) **A1**

NORWAY

(19) NO

(51) Int Cl.

E21D 11/38 (2006.01)

F16B 43/00 (2006.01)

F16J 15/00 (2006.01)

F16J 15/02 (2006.01)

B29C 45/16 (2006.01)

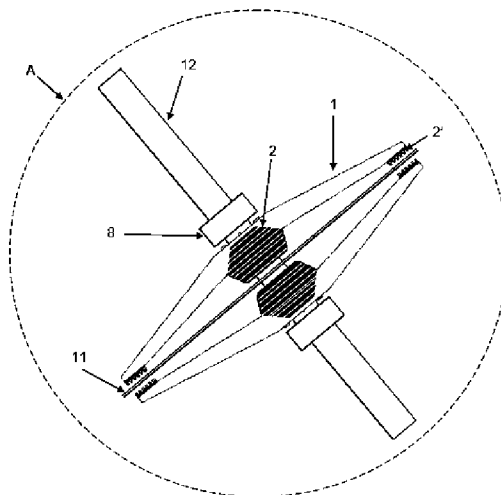
B29C 45/00 (2006.01)

Norwegian Industrial Property Office

(21)	Application nr	20171905	(86)	Int. application day and application nr
(22)	Application day	2017.11.29	(85)	Entry into national phase
(24)	Date from which the industrial right has effect	2017.11.29	(30)	Priority
(41)	Available to the public	2019.05.30		
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(54) Title **DISK FOR FIXING AND SEALING A LINING**
(57) Abstract

Disk for sealed attachment and support of a lining to a supporting surface, such as a wall and/or ceiling in a tunnel, the lining being intended to be fixed to the surface by a number of bolts fixed in the supporting surface by means of one or more discs and a seal, each with a through hole, intended to be threaded onto the corresponding bolt and positioned on at least one side of the lining. Where the seal and the disc form an integrated unit, providing locking and sealing surface around the bolt and the perforation of the lining.



TECHNICAL FIELD OF THE INVENTION

The invention relates to a disk for fixing and sealing a lining to a supporting surface, such as the walls and ceiling of a tunnel, also providing a watertight sealing of perforations in a water and frost protection material, such as lining or insulation in a tunnel/rock as further described in the preamble of the independent claims.

BACKGROUND OF THE INVENTION

In tunnels, on rock walls and similar, there is a need for preventing intrusion of water into the tunnel from the surrounding rock formations. Moreover, there is a need for preventing formation of ice on the inner surface of the lining, i.e. the surface facing the tunnel room, and also possibly for provision of fire protection of the tunnel walls and the ceiling.

Water is leaking out of the rock walls, and during winter this water also tends to freezes, causing a risk of ice masses/icicles falling down. For prevention of such hazard, linings or membranes are widely used before covering the lining with a layer of shotcrete or installing concrete elements. Proper water and frost proofing is a cost-efficient way to extend service life of tunnels, but also to ensure safety of the tunnel both due to accumulation of cracks and/or icicles caused by freezing water.

In order to reduce such hazards where bits of concrete and/or ice may fall down, but also to prevent damage on installed equipment, intrusion of water, frozen road surface or fog, it is known to arrange a watertight and possibly insulating lining or protection on tunnel walls and/or ceilings. The lining or membrane is affixed to the wall and ceiling by means of rock anchor bolts rigidly fixed to the wall and ceiling of tunnels or the rock, the lining being arranged as a continuous lining along the tunnel in lengthwise sections, and crosswise, forming a water tight barrier. The barrier is carried and supported inter alia by the rock bolts. At pointwise locations where lining is threaded onto the anchor bolts, leakages occur due to perforations in the lining made for threading the lining to the rock bolts. Use of plates or discs together with intermediate seals threaded on to the rock bolt, the discs or plates being positioned on each side of the lining at the rear and/or the front of a tunnel lining for sealing purposes and for load bearing purposes, are known. A backing plate with rubber seal at the rear side and a front washer on the opposite side is one example of such use, where the backing plate with rubber seal establishes a sealing between the bolt and plate and the front washer is establishing a sealing by being pressing the front disc onto the lining.

EP 1950375 B1 describes a prior art support for linings with a seal at the outer side of the construction, securing against traversing water intrusion.

Before threading the lining onto the anchor bolts, which may be threaded bolts, disks used for sealing purposes are threaded onto the bolts and acts as a
5 sealing and an inner barrier and back support of the lining, at the rear side of the lining. The disk stops at a predefined distance from the tunnel/rock wall or ceiling by means of a stopping device that may be a nut. A seal for sealing the bolt is either preinstalled onto the disk or retrofitted outside of the disk, facing outwards towards the lining. A seal, covering the disk surface facing the lining, is thereafter installed.

10 Then the lining is installed and the seal preinstalled or retrofitted the disk is sealing both against the bolt and the surface of the lining. A new disk is threaded onto the anchor bolt on the front side of the lining, with or without an additional seal. A new nut is threaded onto the anchor bolt and is tightened in order to keep lining in place and locked position, but also to press the two disks on both side of the lining against
15 each other and making the disks seal even tighter. Washers are installed between the nut and disk in order to distribute load and thereby prevent damages to the disks and the lining, but more important and necessarily to prevent damages to the seal and sealing properties, during tightening of the nut.

When working up under tunnel ceiling, enhanced handle of objects, reduced
20 weight, and installation procedures are important. In order to keep the weight as low as possible, use of steel as such plates mentioned is not a contribution to such enhanced working environment and health, safety and environment. Another challenge is to keep the objects in place while installing further objects. Further, preventing objects from falling off/down and potentially cause injury to the operators
25 and/or cause additional work are of essence.

Further, the steel disks, if not made of stainless steel, are to be coated with anti-corrosion coating preventing formation of rust. When handled during storing, transporting or mounting, the coating might be damaged, which will shorten the lifetime of the disks due to for example formation of corrosion.

30 The number of components has an impact both to cost, but also handling of such a number, causing drawbacks in many aspects. As mentioned above, the handling of such number of components in order to keep them in place while installing further objects, but also the aspect of picking the right component at the right time, is time consuming and the probability to make mistakes is high.

35 The anchor bolts are commonly installed in the tunnel or rock wall and ceiling in a grid pattern at for example a distance of 120 cm x 120 cm. The bolts have

several functions. They are keeping the lining threaded outside disks at a correct distance from the tunnel/rock wall or ceiling around the entire tunnel profile and serves also as an attachment for the lining and reinforcement support for the concrete and the concrete itself, installed outside of the lining. A large number of anchor bolts is needed and a corresponding number of disks and thereby many man-hours for installation. The need of anchor bolts can reach a number of several hundred thousands in one single tunnel dependent upon length, width and height of the tunnel.

A disk is normally made of steel with a diameter of approximately 150 mm and a thickness of 3-4 mm, each with a weight around 0.4 kg and provides good resistance from load due to clamping forces, air pressure and pulling suction of passing trains, cars and heavy goods vehicles.

The lining used may be thin membrane or linings, but may also be foam plates typically at thicknesses of 20-90 mm. PE foam is widely used. When nuts are torqued and the disks are pressed against the foam, the foam will yield. Over time this will cause challenges, since PE does not have any "memories" and will not tend to recover its original shape or thickness when the compressive force is removed. Due to this fact there can be a need for periodically tightening the nuts before spraying on shotcrete or installing concrete elements, tension between the disks and the PE foam will gradually be reduced and the sealing properties will gradually cease, and thereby not function as intended.

SUMMARY OF THE INVENTION

In the following throughout the specification, the following terms means:

The term "lining" used in this specification means a membrane, an insulation sheet, a lining or similar type of installations.

The term "spacer" means a distance piece, preferably cylindrically shaped flat disc, a bushing or the like.

The term "disk material" means filled and unfilled engineering plastics and thermoplastics/polyolefin, including but not limited to PP, PE, PVC, and PA, composites or metals.

The term "seal material" means engineering plastics and thermoplastics/polyolefin, including but not limited to synthetic rubber such as thermoplastic elastomer, TPE or thermoplastic olefin, TPO with a characteristic of being soft, elastic and thereby also deformable, and hold sealing properties when being deformed.

The term “metal” means, include but not be limited to, steel, aluminium, light alloys or the like.

5 An object of the invention is to provide a system for fixing and supporting an element forming a temporary or permanent part of a tunnel wall or roof, preventing debris, water, ice or rock from falling down into a tunnel room or preventing or serving as a fire protection, or serving as an insulation preventing formation of ice on the wall or roof.

10 Another object of the present invention is to provide an improved disc improving the HSE aspects and eliminating, or at least reducing weight exposure during repeatedly installation work, in particular but not limited to above the head work during installation.

Yet another object of the invention is to reduce the number of elements that has to be handled and assembled in order to obtain a more efficient tunnel lining installation system.

15 Yet another object of the present invention is to improve in a simple manner the seal associated with the disc, enhancing the sealing effect of the disc both towards the supporting bolt and also towards the lining as such, preventing intrusion or leakage of water through the lining in the bolt penetration regions.

20 Another object of the invention is to provide elements for such system, such as a disk for mounting a water, frost and fire protecting material, such as a lining, to bolts anchored in rock wall or ceiling, in for example tunnels, and provide a water proof transition between bolts, disk and perforated holes in lining in which the lining is threaded on to the bolts.

25 Moreover it is an object of the present invention is to provide a disk that provides a robust and efficient sealing of the lining of a wall or ceiling of a tunnel or rock.

Another object of the present invention is to extend the lifetime of the disk with a material that cannot rust and will not be damaged due to handling and mounting.

30 Another object of the present invention is to provide a disk with an integrated sealing, eliminating separate mounting of the sealing, either in situ or at the supplier's yard.

Yet another object of the present invention is to provide a disk where the need of additional sealing components is eliminated.

35 Another object of the present invention is to provide a disk with better sealing against anchor bolts and lining.

Similarly, it is an object of the present invention is to provide a disk with better and long lasting sealing to anchor bolts and insulation sheet when installing PE foam

Another object of the present invention is to provide a disk where the need of a washer between the disk and the nut is eliminated.

5 Another object of the present invention is to provide a disk robust to heavy loads.

Another object of the present invention is to provide a disk with reduced weight still maintaining good bending stiffness.

10 It is also an object of the present invention to provide a disk with an integrated sealing, formed by injection moulding in the one and same operation or in a two-step production operation.

Another object of the present invention is to provide a disk allowing a more efficient and cost effective production, thereby reducing the production costs for each specimen.

15 Yet another object of the present invention is to provide a disk allowing a more cost effective installation, also enhancing the health, environment and safety for the operators installing the lining.

20 Another object of the present invention is to reduce labour time and reduce risk of operator while installing lining in walls and ceilings, in for example tunnels, through reduced weight on disks and through integrated component replacing several components and thereby ease handling of components.

The objects of the present invention are achieved by means of a disk as further defined by the independent claims, while embodiments, alternatives, modifications and variants are defined by the dependent claims.

25 In a first aspect, the present invention relates to a disk for sealed attachment and support of a lining to a supporting surface, such as wall and/or ceiling in a tunnel, the lining being intended to be fixed to the surface by a number of bolts fixed in the supporting surface by means of one or more discs and a seal each with a through hole, intended to be threaded onto the corresponding bolt and positioned on
30 at least one side of the lining. The seal is characterized in that the seal and the disc form an integrated unit, providing locking and sealing surface around the bolt and the perforation of the lining.

35 The seal integrated in the disk with an inner seal placed in the centre of the disk and an outer seal placed around the outer rim of the disk intended to face against the steel bolt and the lining.

The inner seal is protruding slightly out of sealing surface of the disk configured to be squeezed towards the surface to be sealed and against the bolt and into the bolt threads when activated, making a water tight transition to the bolt in lining.

5 The outer seal is arranged around the outer rim or circumference of the disk on the surface intended to face towards the lining, and preferably is formed of a number of concentrically arranged ridges.

10 The disk on the side opposite of the sealing surface has several ridges spread in radial direction from centre hole, locking towards a nut when torqued against surface.

On the side opposite the sealing surface, the disk comprises ribs established throughout the circular surface of the disk in order to increase bending stiffness of the disk.

15 The seal is squeezed into centre hole and deformed when pressed against the opposite seal or lining and sufficiently sealing bolt and into the bolt threads and the perforated hole in the lining in which the anchoring bolt is protruding through when lining is installed.

20 At the centre hole of the disk, the inner seal comprises a chamfer on seal, sloped towards the centre hole and the seal surface facing the bolt, and an approximately horizontal surface on the bottom of the inner seal facing the lining.

The disk can be used on both side of the lining, assembled laterally reversed and secured by nuts tightened to press the disks and thereby the seals in the centre of the disk and on the outer rims of the disk on both side of lining toward each other in a water tight manner.

25 The main body of the disk has a disk material, preferably of a plastic or a metallic material, while the disc in total, i.e. the disc with the integrated seal, is made of two different materials/two component material, where disk material is preferably of polypropylene, PP, high density polyethylene, HDPE, polyvinyl chloride PVC, polyamide/nylon, PA or aluminium and seal is preferably made of synthetic rubber
30 such as thermoplastic elastomer, TPE or thermoplastic olefin, TPO.

The seal of the disk is preferably made of a seal material with a shore preferably of 20 A to 90 A, preferably 50 A, but more preferably of 30 A within the shore A hardness scale.

35 The disk with the integrated seal is injection moulded in a two cavity mould for a multi-component injection moulding process.

The disk with the integrated seal can be made in a one-step or a two-step process, where the disk initially is pressed or moulded in a first step and thereafter placed in an injection moulding machine for injection moulding of the seal onto the metal.

5 When the disk is installed on a PE-foam lining, a spacer is installed in perforated hole in the PE-foam lining prior to installation of the disk or it can be pushed through the PE-foam lining by force.

 One method for manufacturing of the disk is in a two step injection moulding process by use of two injection moulding machines where the main body of the disk is pressed or moulded in the first machine and where the main body of the disk is transferred into the mould of the second machine and then overmoulded by the seal material.

10 Another method for manufacturing of the disk is through a one step injection moulding process by use of an injection moulding machine with two injection units where the seal material is overmoulded directly onto the disk material later or immediately after the disk has been moulded, in the same mould, and with the same injection moulding machine where firstly the disk material is injected into an initial mould and secondly the seal material is injected into a secondary mould placed on top of the initial mould by rotating a core mould.

15 Yet another method for manufacturing of the disk in a two-step process, first step of metalworking, either pressing or casting the main body of the disk, followed by an injection moulding process by use of an injection moulding machine where the seal material is overmoulded directly onto the metal piece, placed into the same cavity as for injection moulding of the main body of the disk as described above.

20 The seal is sufficiently sealing the perforated hole in the material for water and frost protection in which the anchoring bolt is protruding through after installation of water and frost protecting material.

 The disk is for securing a water and frost tight barrier at perforation in the lining while fixing a lining to a wall or ceiling of a tunnel where the lining is threaded onto anchor bolts and where disks act as the water and frost tight sealing of the lining and bolt. The disk is installed at a predetermined distance from the tunnel walls or ceilings, and the disks are threaded onto a number of anchor bolt, preferably threaded bolts, which is bolted to the tunnel walls or ceilings, the disks stops at a predefined distance of the tunnel walls or ceilings at a preinstalled stopping means, which can be a nut, the seal turning outwards. The lining is thereafter threaded at perforations in lining onto the anchoring bolts, which is preferably spreading at a

distance from each other throughout the tunnel, new disks are threaded onto the bolts, the opposite way of the disks firstly installed, a new stopping mean, which can be a nut, is threaded onto the bolts and tightens the disks on both side of the lining towards each other. The more it is tightened the better sealing effect, the seal in the centre of the disk is being squeezed inwards and embraces the anchoring bolt tighter and tighter and the seal in the disk circumferences gains tighter and tighter contact with the lining with increased pressure on disk from the torqued nut.

According to the present invention the means for sealing off the lining also serves as a securing element securing the water and frost proofing lining to the tunnel or rock wall or ceiling at a predefined distance to the tunnel or rock wall or ceiling.

According to the present invention the disk is provided with ribs for stiffening purposes in order for the disk to be able to withstand heavy loads.

The discs and the method according to the present invention provides a lighter disc of a plastic material with integrated sealing, where the integrated sealing is formed in the same moulding operation and by the same tool as the moulding of the disc.

Both costs associated with the manufacture and installation process are reduced, due to the integrated sealing as part of the moulding of the disc and due to elimination of components related to the integrated seal in disk which leads to easier and more efficient handling at tunnel site.

Due to the integrated sealing, the discs also provide a more reliable sealing effect with reduced exposure for a leakage between the sealing, the disc and the rock bolt.

The disk with the integrated seal is made of two different materials one stiff material to keep the strength and the shape and one material to function as a seal. The stiff material can be thermoformed or compressing moulded of for example polypropylene, PP, high density poly ethylene, HDPE, polyvinyl chloride, PVC or polyamide/nylon PA and the seal material can be synthetic rubber such as thermoplastic elastomer, TPE or thermoplastic olefin, TPO. The stiff material can also be a filled material with for example glass to gain extra stiffness. It can also be filled with flame retardant to prevent from burning. The sealing, of for example TPE or TPO, has a hardness in the shore A hardness scale within the area of 20-90 A, preferably with a shore 50 A, and more preferably with a shore 30 A may be preferably. Different shore on inner and outer sealing might be preferred, and then preferably with a lower shore on the inner sealing.

The health, safety and environmental aspect is also improved due to the reduced weight of each disc compared with a steel disc.

The challenge with the PE foam, where the tension between the disk and lining will be loosening, can be solved by applying a spacer in the perforated hole in the PE foam, thereby reducing the compressive effect on the insulation foam in itself. This secures a solid sealing face towards the seal in area of the anchoring bolt, and thereby secure sealing.

The disk can also be applied outside rocky walls where bolts is rigidly fixed in order to secure bits of rocks from falling out either because of unfixed rocks or where water intrusions makes conditions where bits of rocks loosen. Disks are then used to prevent water additional intrusion along the anchoring bolt.

The disk manufactured in either a one step injection moulding process or in a two step injection moulding process, where the two step injection moulding process is using two injection moulding machines where the disk material is moulded in a first machine and where the component of disk material are transferred into the mould of a second machine and then overmoulded by the seal material. And the one step injection moulding process is using one injection moulding machine with two injection units where the seal material is overmoulded directly onto the disk material (filled and unfilled engineering plastics and thermoplastics/polyolefin and composites) immediately after the disk material has been moulded, in the same mould, and with the same injection moulding machine where firstly the disk material is injected into an initial mould and secondly the seal material is injected into a secondary mould placed on top of the initial mould by rotating a core mould. The one step injection moulding process, also known as 2-Shot-, multi-component-, in-mould-, twin shot- or assembly injection moulding process creates a strong, tight seal without the need for additional components and is a preferred manufacturing method for products where water-tightness is required.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the following diagrams wherein:

Figure 1 shows schematically a cross section of an illustration of prior art.

Figure 2 shows schematically a cross section through a tunnel, prior to further reinforcement and shotcreting/concreting or installing concrete elements, indicating a lining, a plurality of anchoring bolts and disks for sealing.

Figure 3 shows a cross section of detail A from figure 2, showing the present invention assembled with the lining in a tunnel.

Figure 4 shows a cross section of detail A from figure 2, showing the present invention assembled with the lining in a tunnel, where the lining is a thick PE-foam with a spacer through a perforation in the foam.

Figure 5 shows a perspective view of one embodiment of a disk of the present invention.

Figure 6 shows a tilted perspective view of figure 5.

Figure 7 shows a cross section A-A of one embodiment of a disk of the present invention.

Figure 8 shows a top view of one embodiment of a disk of the present invention indicating the cross section A-A in figure 7.

Figure 9 shows a detail B from figure 7 of the centre part of the seal.

Figure 10 shows a side view of two disks of the present invention

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS DISCLOSED IN THE DRAWINGS

The following description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. The following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

Reference throughout the specification to “one embodiment” or “an embodiment” means that a particular feature, structure or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases “in one embodiment” or “in an embodiment” in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

Figure 1 shows schematically a cross section of an assembly of prior art. A bolt to be anchored to the tunnel wall, a nut at a predefined distance from the tunnel wall which act as a stopping means for the lining, a washer between the nut and a seal preinstalled or retrofitted in the centre hole of the sealing disk, a sealing sheet at least covering the disk area between the disk with the seal and the lining, a new disk, with or without seal outside the lining a washer between the outer disk and the nut which is torqued in order to the disks against the lining and make a water proof

transition between the anchoring bolt and lining. The washers are required in order to prevent damages to the seals, and thereby the sealing properties, and disks when torqued against the nut.

Figure 2 shows schematically a cross section through a tunnel, prior to further reinforcement and shotcreting or installing concrete elements, indicating a lining 11, a plurality of anchoring bolts 12 and disks 1 for sealing. As indicated, a plurality of anchoring bolts 12 is drilled into the surrounding rock and penetrating the lining 11. In order to secure water tightness, the penetration is sealed, and conventional sealing material with load distributing disks 1 is used. The lining 11 may be of flexible and bendable sheets extending for example as a unit following the entire profile shape of the tunnel. In the longitudinal direction of the tunnel, sections of transversely extending lining 11 sheets are arranged in an overlapping pattern. The lining 11 may also be of thick PE foam with thicknesses from 20-90 mm.

Figure 3 shows a cross section of detail A from figure 2, showing the present invention assembled with the lining in a tunnel wall 10. A bolt 12 to be anchored to the tunnel wall 12, a stopping means, which might be a nut 8, is installed at a predefined distance from the tunnel wall 10 which act as a stopping means and keeps the lining 11 at a desired distance from the tunnel wall 10, the disk 1 with the integrated seal 2, 2', with the seal 2, 2' facing outwards, then the lining 11 is threaded outside the disk 1, a new disk 1 is installed by threading onto the bolt 12 outside the lining 11, the opposite way of the disk 1 firstly installed, a new nut 8 is threaded onto the bolt 12 and being tightened in order to press the disks 1 on both side of the lining 11 towards each other, and thereby pressing the seal 2, 2' to squeeze the sealing. An inner seal 2 arranged in the centre of the disk 1 is pressed to squeeze against the bolt 12, and secures a water proof transition along the bolt 12. And an outer seal 2' arranged around the outer rim of the disk 1 will be squeezed towards the lining 11 and secures a water proof transition in the interfaces exposed to possible and unwanted water.

Figure 4 shows a cross section of detail A from figure 2, showing the present invention assembled with the lining 11 in a tunnel wall 10, where the lining is a thick PE-foam with a spacer 9 through a perforation in the foam. The principle is the same as indicated in figure 3, but because the foam is a flexible material, that will yield when being pressurized; a spacer 9 is installed in the perforation of the lining 11 where the lining 11 is threaded onto the anchor bolt 12. The spacer 9 functions as a resistance for the disk's 1 inner sealing 2 in order to be able to be squeezed against a solid surface and thereby the inner seal 2 is deformed to squeeze against the bolt

12 making a water proof transition. A chamfer on both sides of the spacer 9, inclining towards the centre axis of the thorough hole of the spacer 9, makes the seal 2 being squeezed into the spacer 9 and towards the bolt 12 while being pressurized by the torqued nuts 8, and also seals the thorough hole of the spacer 9. When using PE-
 5 foam as lining, the disks (1) are dependent upon a spacer 9, in order to press the seal 2 against the bolt 12 and thereby the threads of the bolt 12.

Figure 5 shows a perspective view of one embodiment of a disk 1 of the present invention, the disk 1 shown from above. The ribs 4 which both stiffen and reduce weight of the disk 1 are shown. The ridges 6 are shown spread in radial
 10 direction from centre hole 5, to first prevent minimum friction to the nut when turning the nut and thereafter locking towards a nut 8 when torqued against surface, where ridges will be deformed to lock the nut and replacing the washers shown in prior art and where the ridges 6 also are deformed in order to lock the nut 8.

Figure 6 shows a tilted perspective view of figure 5, the disk seen from below, and constitutes the sealing side of the disk. The inner seal 2 is shown in centre of the disk, with flow channels where which the sealing material flows during injection moulding towards the outer rim of the disk forming the outer seal 2', around the outer rim of the disk. The outer seal 2' which is spread from the inner seal 2 to the outer rim of the disk 1 is of importance to be able to further secure a water tight transition
 15 between lining 11 and the disk 1, and also to take water leakages from the perforated hole, because size of perforated hole in lining might vary.

Figure 7 shows a cross section A-A of one embodiment of a disk 1 of the present invention. The disk 1 and the seal 2, 2' forming an integrated part are separately indicated. The seal 2, 2' is shown to be continuously from centre hole 5 to the outer rim of the disk 1. The main body of the disk 1 is made of disk material. The seal 2, 2' is made of a seal material. The seal material has a shore within the shore
 20 A hardness scale and preferably with a shore 30A, but might also be of shore 50 A, and at least within a shore of 20-80 A. Different shore on inner and outer part of sealing might be preferred, and then preferably with a lower shore of the inner sealing than the outer sealing.

Figure 8 shows a top view of one embodiment of a disk 1 of the present invention indicating the cross section A-A in figure 7.

Figure 9 shows a detail B from figure 7 of the inner seal 2. The inner seal 2 shows a chamfer on seal 3, where the chamfer on seal 3 is on the outer surface of the inner seal 2, inclining towards the centre hole 5 of the disk 1, making it gradually
 35 thinner to the bottom of the sealing surface of the disk in order to make it softer and

thereby ease squeezing of the material inwards towards the bolt 12 when being pressurized. An approximately horizontal surface on the bottom of the inner seal 2 facing the lining 11 is also shown; making a bigger contact area for the inner seal 2 facing either lining 11 or the inner seal 2 of the opposite disk 1, dependent on the size of perforated hole in lining 11.

Figure 10 shows a side view of two disks 1 of the present invention as it will be placed opposite each other with the lining 11 between.

Table 1

1	Disk
2, 2'	Seal
2	Inner seal
2'	Outer seal
3	Chamfer on seal
4	Ribs
5	Centre hole
6	Ridges
7	Sealing side
8	Nut
9	Spacer
10	Tunnel or rock wall or ceiling
11	Lining
12	Bolt

CLAIMS

1 . Disk (1) for sealed attachment and support of a lining (11) to a supporting surface, such as a wall and/or ceiling in a tunnel (10), the lining (11) being intended to be fixed to the surface by a number of bolts (12) fixed in the supporting surface by means of one or more discs (1) and a seal (2, 2'), each with a through hole, intended to be threaded onto the corresponding bolt (12) and positioned on at least one side of the lining (11)

characterized in that a seal (2, 2') and the disc (1) form an integrated unit, providing locking and sealing surface around the bolt (12) and the perforation of the lining (11).

2. Disk (1) according to claim 1, wherein the seal (2, 2') integrated in the disk (1), with an inner seal (2) placed in the centre of the disk (1) and an outer seal (2') placed along the outer rim of the disk (1), is intended to face against the steel bolt and the lining.

3. Disk(1) according to claim 1 or 2, wherein the inner seal (2) is protruding slightly out of sealing surface of the disk (1) configured to be squeezed towards the surface to be sealed and against the bolt (12) and into the bolt threads when activated, making a water tight transition to the bolt (12).

4. Disk (1) according to one of the claims 1 to 3, wherein the outer seal (2') is arranged around the outer rim or circumference of the disk (1) on the surface intended to face towards the lining (11), and preferably is formed of a number of concentrically arranged ridges..

5. Disk (1) according to one of the claims 1 to 4, wherein the disk (1), on the side opposite the sealing surface, has several ridges (6), spread in radial direction from centre hole (5), locking towards a nut (8) when torqued against surface.

6. Disk (1) according to one of the claims 1 to 5,
wherein the disk (1), on the side opposite the sealing surface, comprises ribs (4)
established throughout the circular surface of the disk (1) in order to increase
bending stiffness of the disk (1).

5

7. Disk (1) according to one of the claims 1 to 6,
wherein the seal (2, 2') is squeezed in to centre hole (5) and deformed when pressed
against the opposite seal or lining and sufficiently sealing bolt (12) and into the bolt
threads and the perforated hole in the lining in which the anchoring bolt (12) is
protruding through when lining (11) is installed.

10

8. Disk (1) according to one of the claims 1 to 7,
wherein the inner seal (2) at the centre hole (5) of the disk (1) comprises a chamfer
on seal (3), sloped towards the centre hole (5) and the seal surface facing the bolt
(12), and an approximately horizontal surface on the bottom of the inner seal (2)
facing the lining (11).

15

9. Disk (1) according to claim 1 to 8
wherein the disk (1) can be used on both side of the lining (11), assembled laterally
reversed and secured by nuts (8) tightened to press the disks (1) and thereby the
seals (2, 2') in the centre of the disk and on the outer rims of the disk (1) on both side
of lining (11) toward each other in a water tight manner.

20

10. Disk (1) according to claim 1 to 9
wherein the main body of the disk (1) is made in a plastic or metallic material, while
the disk (1) in total, i.e. the disk with the integrated seal (2, 2') is made of two
different materials/two component material, preferably polypropylene, PP, high
density polyethylene, HDPE, polyvinyl chloride, PVC, polyamide/nylon, PA or
aluminium and synthetic rubber such as thermoplastic elastomer, TPE or
thermoplastic olefin, TPO.

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11. Disk (1) according to claim 10
wherein the seal (2, 2') of the disk (1) is preferably made of a material with a shore of
20 A to 90 A, preferably of 50 A, but more preferably of 30 A within the shore A
hardness scale.

35

12. Disk (1) according to claim 11

wherein the disk (1) with the integrated seal (2,2') can be injection moulded in a two cavity mould for a multi-component injection moulding process.

5 13. Disk (1) according to claim 12

wherein the disk (1) with the integrated seal (2, 2') can be made in a one-step or a two-step process, where the disk (1) initially is pressed or moulded in a first step and thereafter placed in an injection moulding machine for injection moulding of the seal (2, 2') onto the metal.

10

14. Method for installation of disk (1) on a PE-foam lining (11), wherein a spacer (9) is installed in perforated hole in the PE-foam lining (11) prior to installation of the disk (1) or it can be pushed through the PE-foam lining (11) by force.

15 15. Method for manufacturing of the disk (1) in a two step injection moulding process by use of two injection moulding machines where the main body of the disk (1) is pressed or moulded in the first machine and where the main body of the disk (1) is transferred into the mould of the second machine and then overmoulded by the TPE or TPO material.

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16. Method for manufacturing of the disk (1) in a one step injection moulding process by use of an injection moulding machine with two injection units where the TPE or TPO is overmoulded directly onto the PP, HDPE, PVC or PA later or immediately after the PP, HDPE, PVC or PA has been moulded, in the same mould, and with the same injection moulding machine where firstly the PP, HDPE, PVC or PA is injected into an initial mould and secondly the TPE or TPO is injected into a secondary mould placed on top of the initial mould by rotating a core mould.

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17. Method for manufacturing of the disk (1) in a two-step process, first step of metalworking, either pressing or casting the main body of the disk (1), followed by an injection moulding process by use of an injection moulding machine where the TPE or TPO is overmoulded directly onto the metal piece, placed into the same cavity as for injection moulding of the main body of the disk (1) as described in claim 15.

30

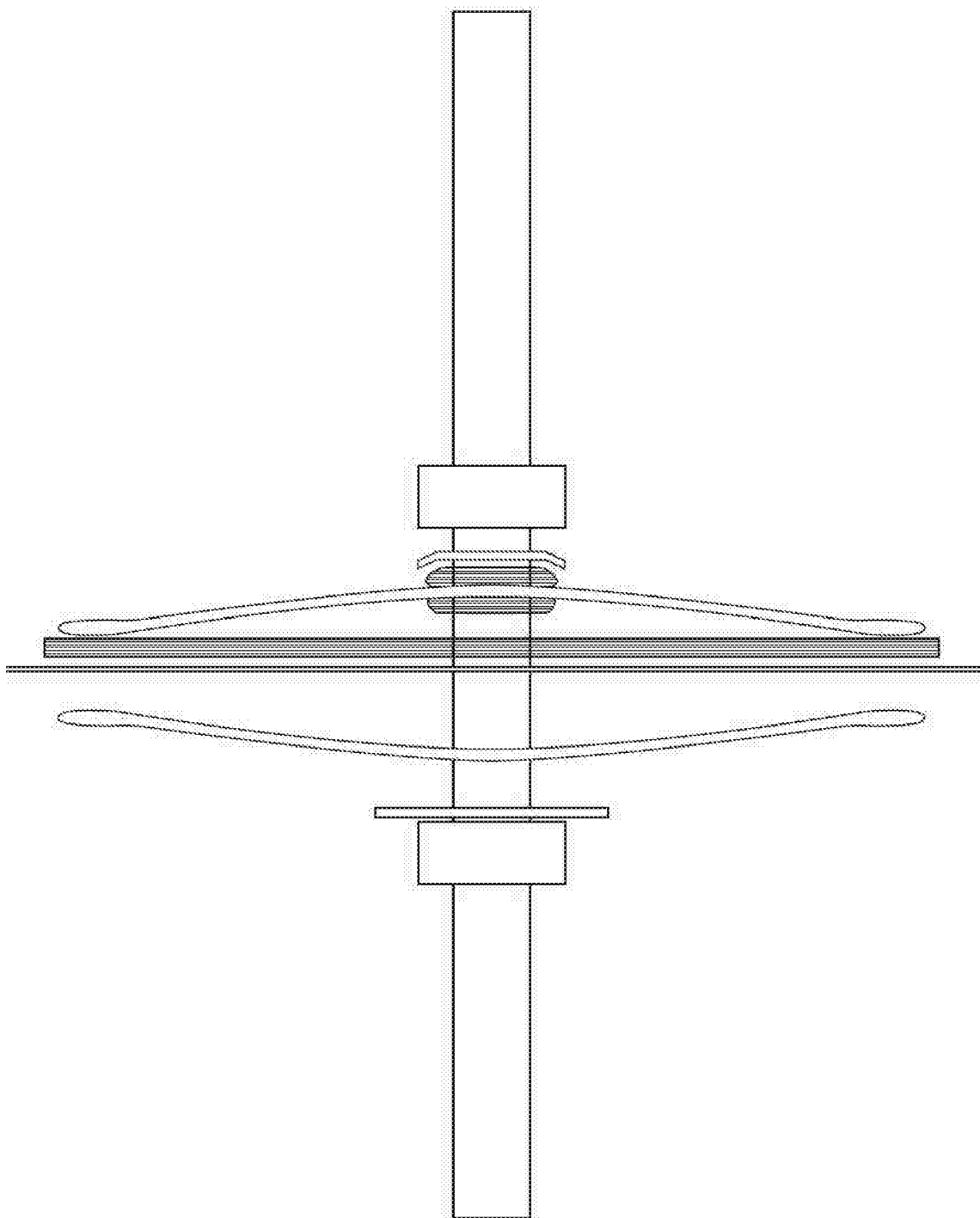


Fig. 1 (Prior art)

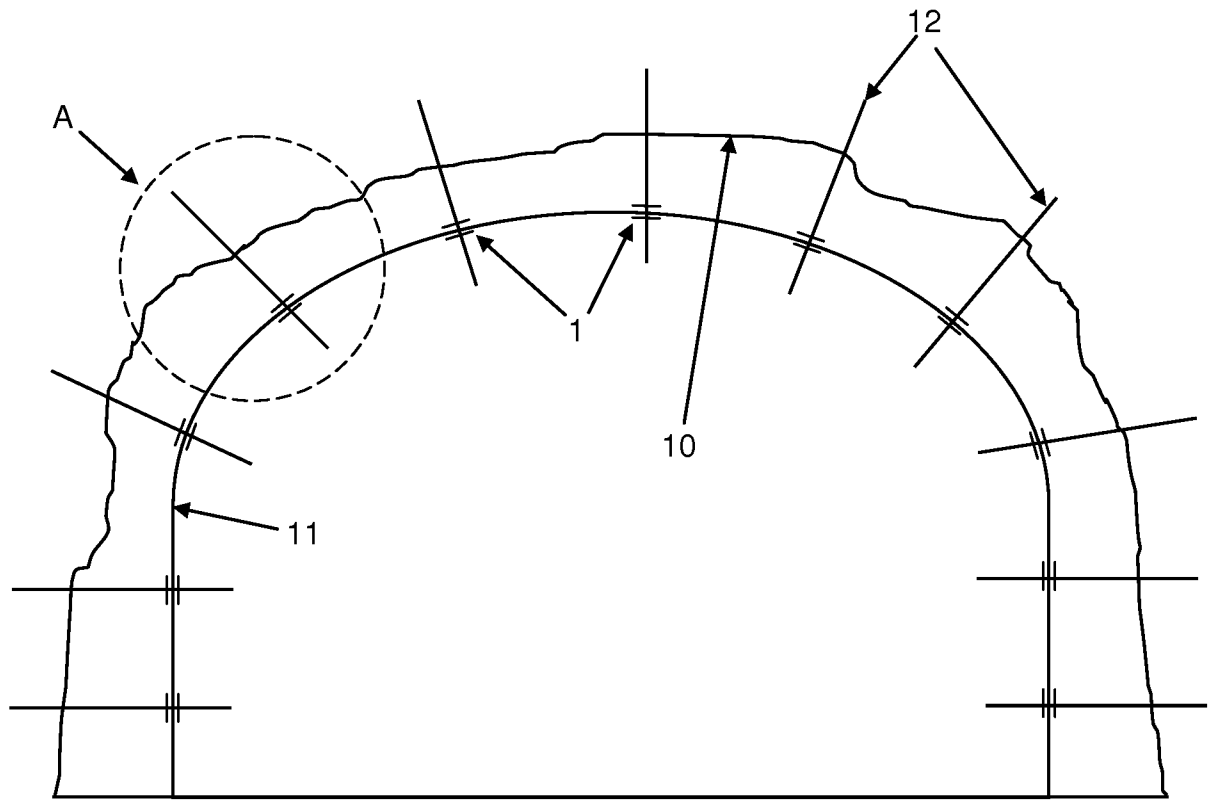


Fig. 2

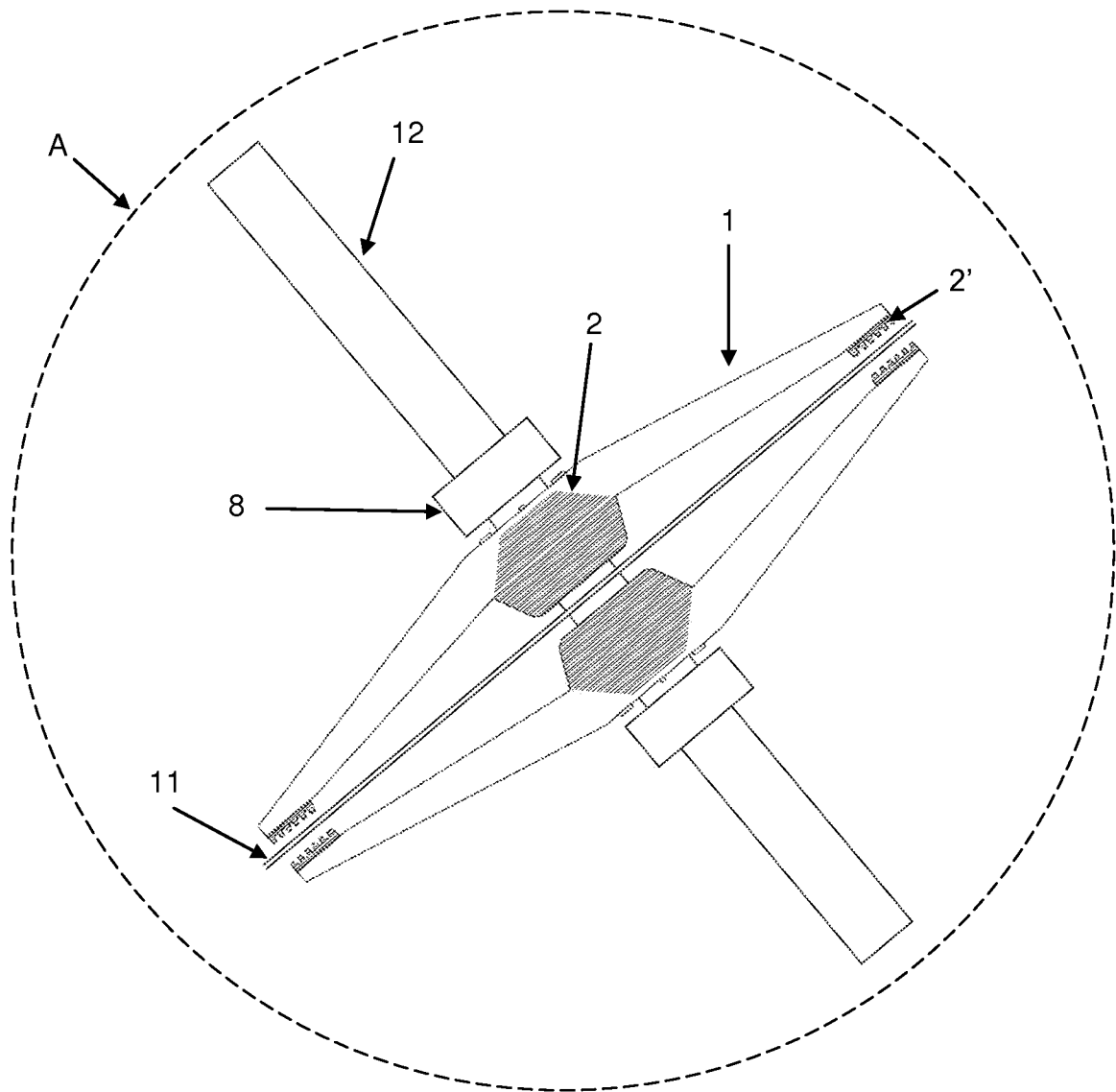


Fig. 3

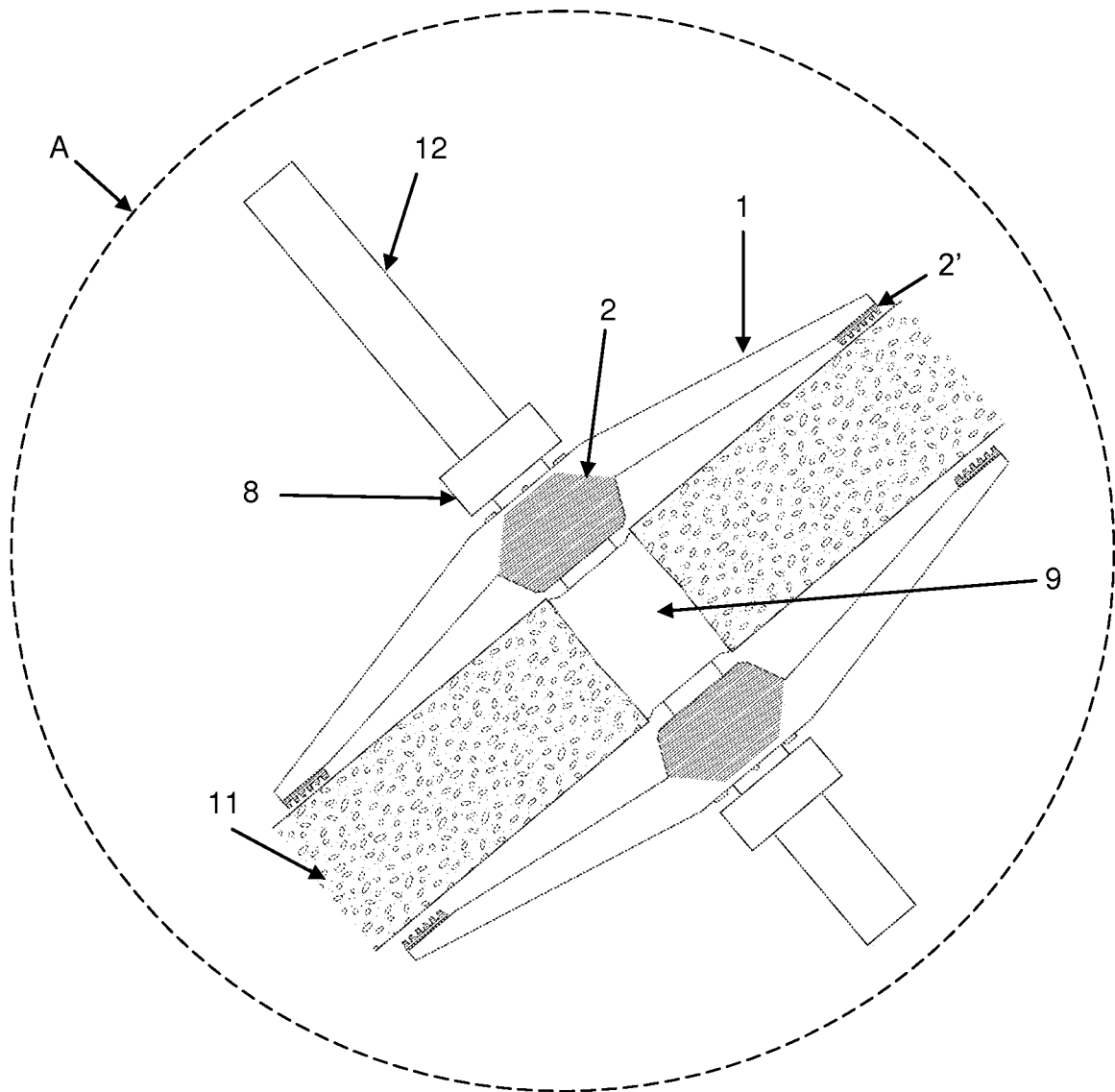


Fig. 4

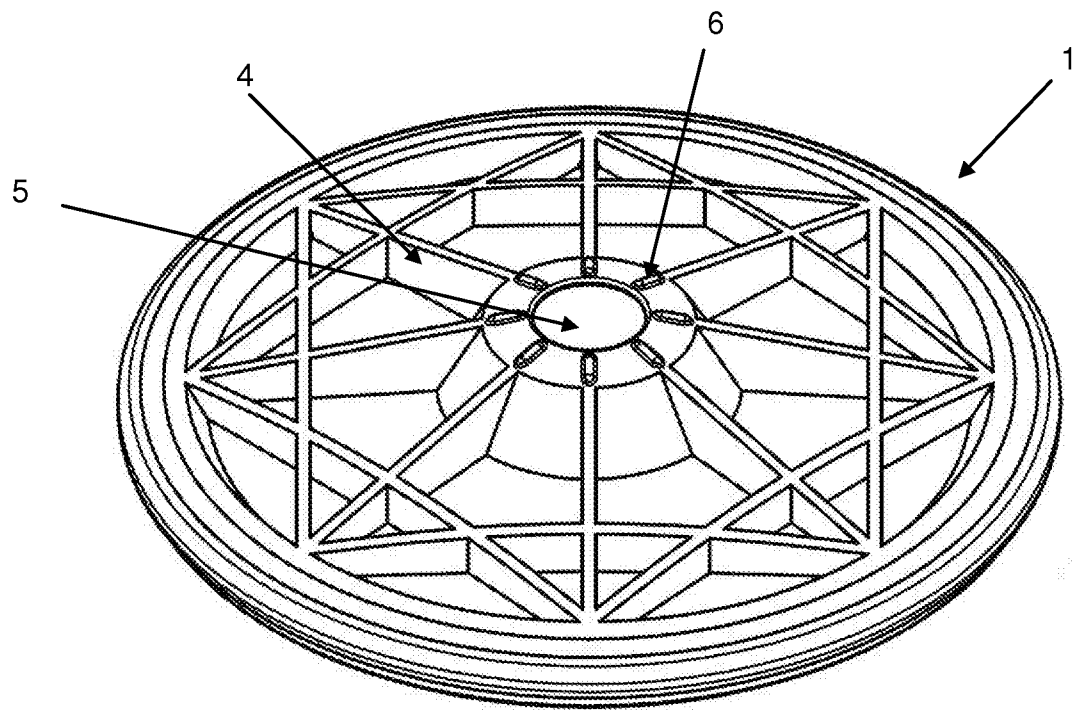


Fig. 5

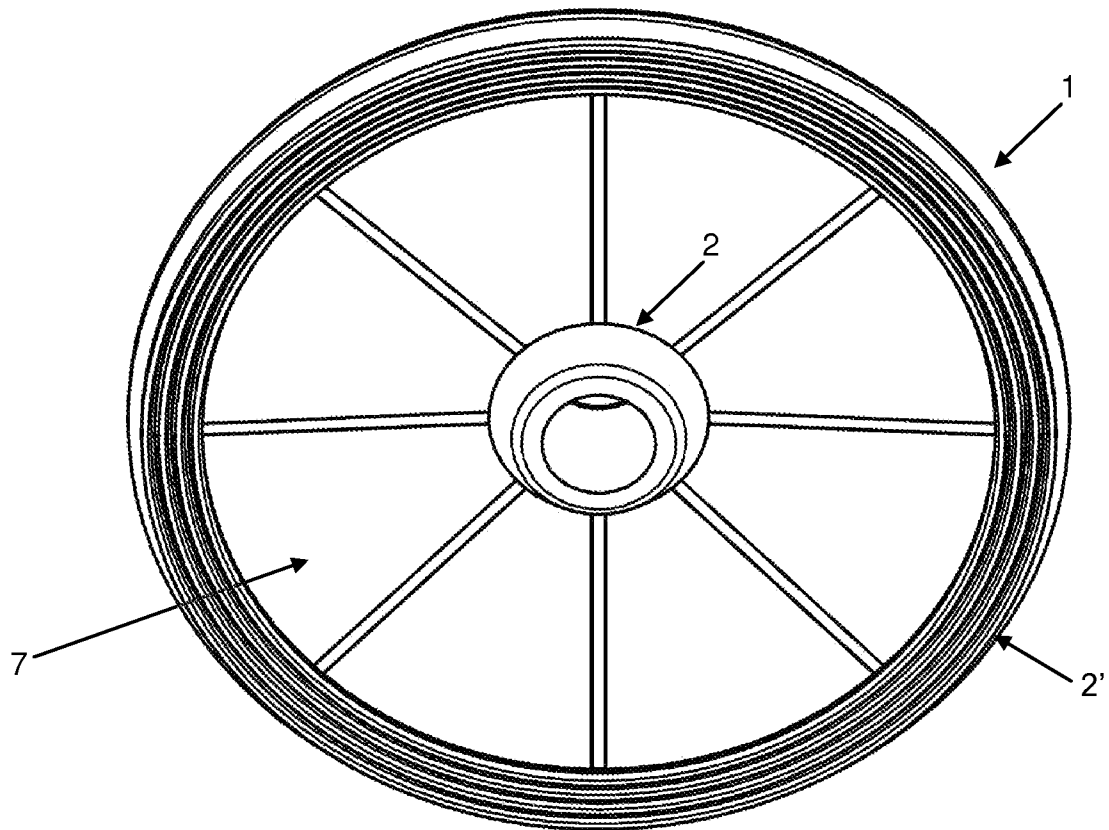


Fig. 6

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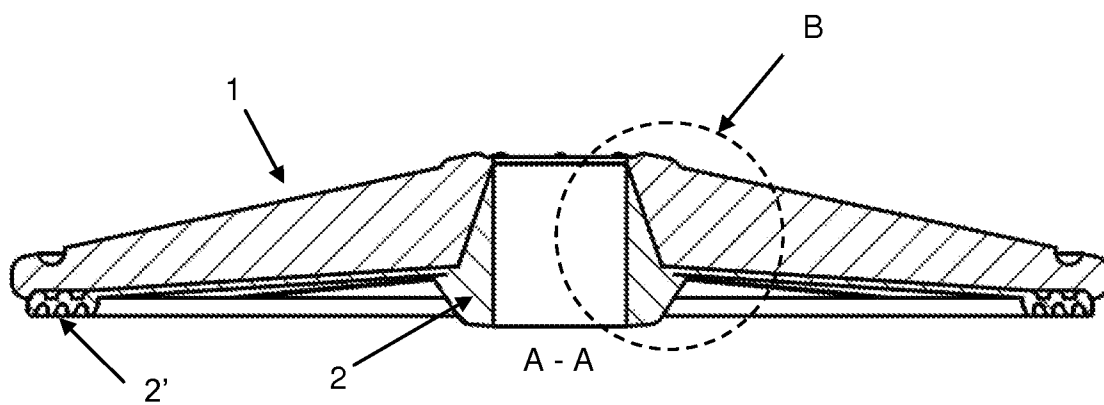


Fig. 7

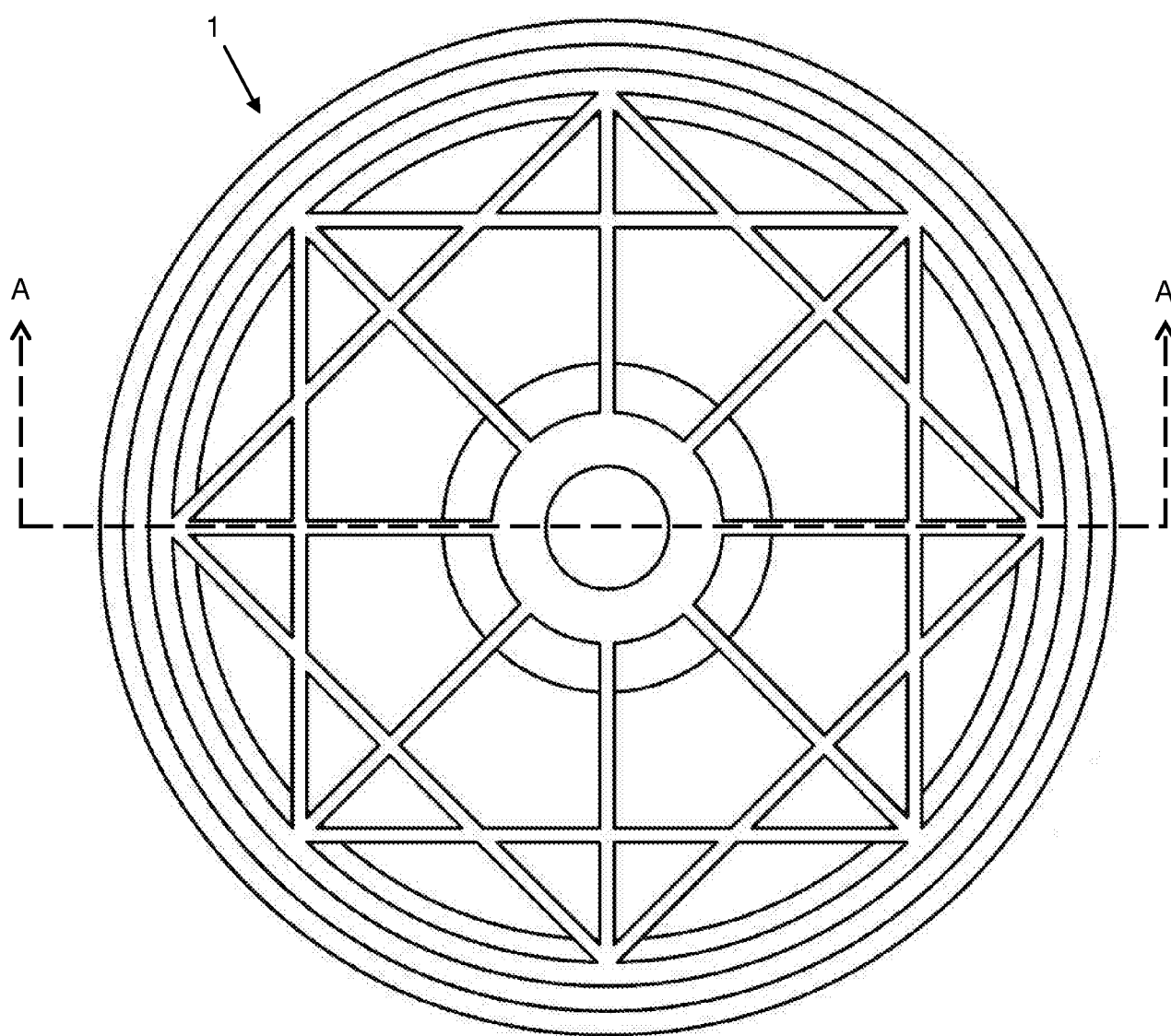


Fig. 8

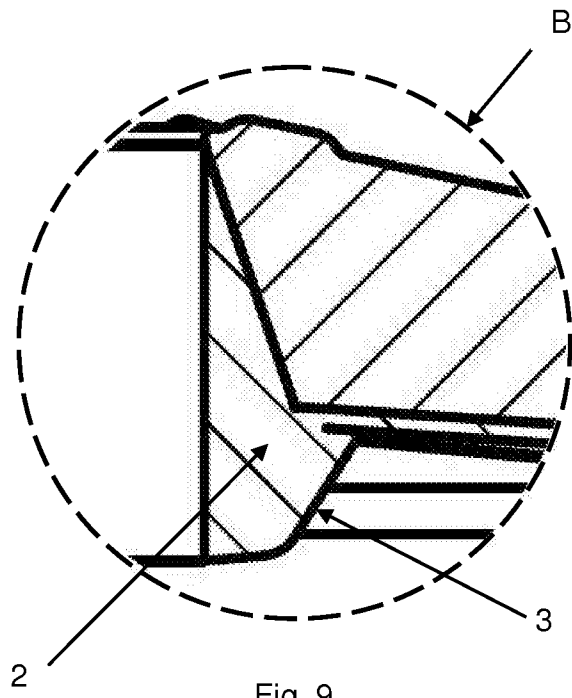


Fig. 9

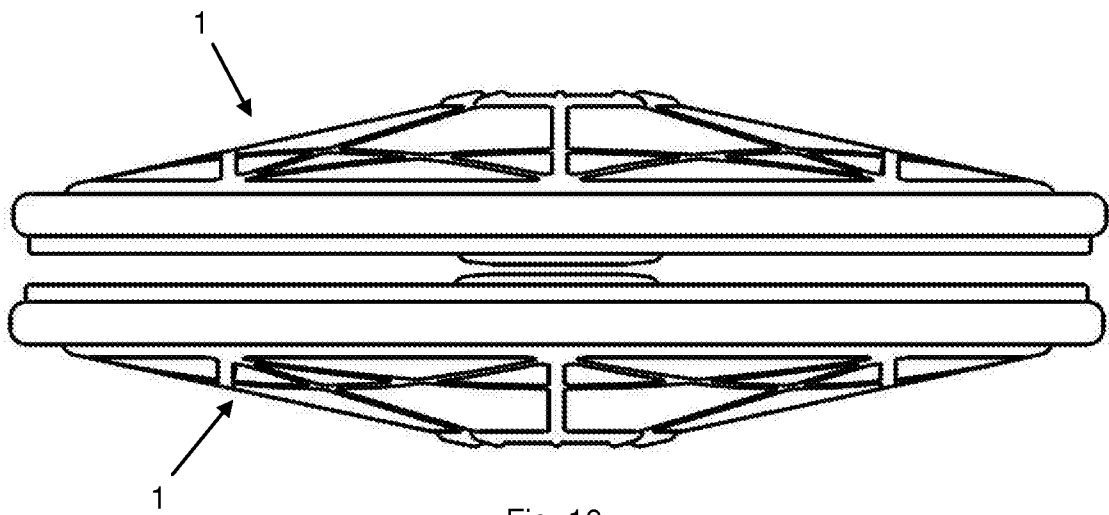


Fig. 10